June 1, 1998

Draft

Diversion Effects on Fish Populations.

CALFED Alternatives Evaluation for Striped bass.

(THIS IS A MODIFIED VERSION OF THE STRIPED BASS PAPER PREPARED BY THE DIVERSION EFFECTS SUBTEAM OF CALFED. AG/URBAN SCIENTISTS HAVE PROVIDED COMMENTS WHICH ARE INCORPORATED IN THIS DOCUMENT IN BOLD ITALIC TYPE)

This is a response from the striped bass diversion effects team to the questions and comments raised by CUWA/AG consultants. Responses are in red bold font. Where appropriate, we will revise the text of the document to reflect the concerns of the reviewers and send out a new version or they may get incorporated in the committee draft.

Introduction- Evaluation Team and Process:

The CALFED task of evaluating diversion effects on fish was divided into species sub-committees. The striped bass subgroup met twice and evaluated the diversion impacts of the alternatives based on information provided in the CALFED Phase II report and in operation studies provided.

The striped bass evaluation is based on a review by biologists with knowledge of the striped bass population and historic relationships ***(MANY OF OR DISAGREEMENTS WITH RESPECT TO STRIPED BASS HAVE CENTERED ON THE VERY ISSUE OF WHETHER OR NOT THE ESTUARY WILL RESPOND IN THE FUTURE AS IT HAS IN THE PAST. GIVEN ALL OF THE CHANGES IN FAUNA, NUTRIENT DYNAMICS, OPERATIONS, SUPPOSED FLOW RELATIONSHIPS, ETC., WE SERIOUSLY QUESTION WHETHER OR NOT THE POPULATION OF STRIPED BASS WILL RESPOND IN THE MANNER WHICH MIGHT HAVE BEEN PREDICTED FROM HISTORICAL MODELING EFFORTS. OUR RESPONSE HAS BEEN NO FOR A VARIETY OF REASONS, INCLUDING: 1) THE OLD STRIPED BASS MODEL HAS BEEN THOROUGHLY DISMISSED BY A NUMBER OF BIOLOGISTS AND FOX AS BEING INADEQUATE. THIS MODEL BASICALLY SHOWED MORE OUTFLOW PRODUCED MORE STRIPED BASS, 2) KIMMERER'S WORK WHICH CALLS INTO QUESTION THE DENSITY INDEPENDENT ASSUMPTIONS WITH RESPECT TO LARVAL ABUNDANCE AND THREE YEAR OLD ADULTS. WIM'S ANALYSIS SEVERELY QUESTIONS THE RELATIONSHIP BETWEEN LARVAL ABUNDANCE AND ADULT POPULATION LEVELS, 3) DFG HAS CONTINUED TO ASSERT IN RECENT YEARS THAT ADULT POPULATION LEVELS WERE INSUFFICIENT TO PROVIDE AN ADEQUATE LEVEL OF EGG DEPOSITION AND THUS REPRODUCTIVE POTENTIAL WAS TOO LOW TO***

SUPPORT A POPULATION REBOUND. HOWEVER, RECENT DATA AND ANALYSES BY SOME DFG EMPLOYEES ARE QUESTIONING THIS ASSUMPTION OF LOW EGG DEPOSITION, 4) GIVEN ALL OF THE CHANGES IN SPECIES COMPOSITION IN THE ESTUARY, IT IS POSSIBLE THAT STRIPED BASS MAY NOT RESPOND IN AN HISTORICAL MANNER, AND 5) THE MOST COMPELLING EVIDENCE OF THE OLD HYPOTHESIS AND RESPONSE BEING OF QUESTIONABLE VALUE IN PREDICTING STRIPED BASS SUCCESS IS THE FACT THAT WE HAVE HAD WET YEARS IN 93, 95, AND 96 AND THE STRIPED BASS INDICES HAVE NOT INCREASED. IN FACT, THEY HAVE HOVERED NEAR ALL TIME LOWS.)

The reviewers seem to expect more than was possible in the time frame and beyond the insights of the participants. It is clearly stated in the paper that there was no time for anything but a judgemental assessment of relative merits of the alternatives vs existing conditions. If CALFED wanted more quantitative analysis, then more staff time and a much longer time frame should have been provided. However, the result could be much the same given the many uncertainties which were also addressed in the document. It is likely that these uncertainties will not go away as a result of more analysis and modeling.

Historic relationships are necessarily what we must base our evaluations on. We are obviously less certain of future relationships since the future is likely to be one of continued environmental change. It is true that many factors have changed over time and it is possible that the population may not recover today if the delta hydraulics were restored to pre-project conditions. The Oakridge National Laboratory Individual Based Model results (draft report is in preparation by Kenny Rose) indicate that diversions and food supply variables together account for the decline in striped bass. However, if only diversions were set at pre-bass decline levels in the model, the population would recover to a stable population of about 1.5 million adults which, though not the historic measured high of 1.8 million, is evidence of the importance of diversions in driving the striped bass population decline. Food by itself in the model caused only a decline to 1.5 million adults but when food and diversions are in the model the populattion declined to 0.5 million. Basicly this supports the work that has been done previously by the DFG in identifying

diversions as the major factor in the decline (Stevens et. al., 1985, Exhibit 25, WRINT exhibits 2 and 3; IEP annual Reports).

The DFG striped bass model is not predicting the low 38 mm abundance indices in recent high flow years suggesting that all factors may not be adequately addressed by this model. This has cast doubts about the model that DFG staff is well aware of. This does not mean the outflow and diversions were not historically important as defined in the model. This does not mean that egg production is unimportant. However, it is likely that other factors are not accounted for in the model that may be responsible for low recent low abundances when ouflow has been high. DFG folks need to sort this out, have been working to do this, e.g., Foss and Miller, Miller and Foss IEP Newsletters. In the last article, they stated that the egg production for 1996 should have been about 1/3 of the 1994 egg production in order for poor1996 survival to be included within the historic variation of the egg to 38 mm survival-delta outflow relationship. Recently we obtained estimates of 1996 egg production which indicated that it was ½ the 1994 production thus suggesting that recent low indices are the result of egg limitation.

With respect density-dependence, we assume the reviewers refer to Kimmerer, et al., and their manuscript, " Analysis of Striped bass population of the San Francisco Estuary: Effects of freshwater flow as moderated by density-dependence", we have the following comments. First, we can point out that DFG staff and a group of consulting scientists working on this issue in about 1980 identified density-dependence as a factor in striped bass population dynamics and this was described in the "Black Book", the name given to one of the early evaluations of the striped bass decline.

However, the density-dependent survival does not fully compensate for the effects of starting with fewer young-of-the-year striped bass. The adult population was 1.8 million in early 1970's and has declined to about 0.5 to 0.7 million in the 1990's. This decline in

adults is consistent with the general declines in egg abundance and the 38 mm index of young bass (juveniles, not larvae as stated in the review) abundance. There is insufficient compensation to offset the decline in egg production which has gone from 319 billion in 1969, down to 31 billion, in 1996, an order of magnitude decline in egg production vs only about a 2/3 decline in the number of adults. We do not think that Kimmerer, et. al., states that diversions or flows or egg production are not important factors affecting striped bass abundance or survival. In fact, Kimmerer, et al., states "the median losses to pumping were estimated at 33 percent, a substantial fraction of the total mortality and losses were often much higher." Our view is that these mortalities are only partially offset by density dependent survival as we have stated.

We are unaware of any questions raised recently by any DFG biologists that, "questions the assumption of low egg deposition." Low egg production is a fact not an assumption (see above paragraphs), but its importance has not been questioned recently to our knowledge. We do question why the DFG model's capabilities to predict YOY abundance in recent years based on the egg production estimates is poor and we have no answer at this point.

It is clear that Delta diversions have had a major impact on striped bass, whose nursery area historically has been the Delta and Suisun Bay. The issue here is which alternative is best for striped bass and that is the issue we attempted to address and not issues of increased adult mortality in the ocean or others unrelated to the alternative evaluation of impacts of diversions on striped bass in the Delta.

of egg and larva distribution and abundance, young-of-the- year abundance, and adults in relation to estuarine conditions and historic changes. Participants on the work team are Stephani Spaar, Department of Water Resources, David Kohlhorst, Lee Miller, Kevan Urquhart, and Don Stevens, Department of Fish and Game. Elise Holland, Bay Institute was a member of our team but was unable to attend meetings when the matrices of diversion effects were developed. This report is the result of the interactions of this group.

Methods:

We completed matrices for: existing conditions, no action conditions (projection of increased demand on existing facilities), common programs, diversion alternatives 1, 2, and 3 and full restoration. We adopted a scale of -5 to +5 to express the relative impact of effects identified in the matrix as major components that would affect striped bass in relation to water diversions. Evaluations were based on qualitative assessments *(DO WE HAVE CRITERIA USED? IT IS IMPORTANT THAT THE TEAM DOCUMENT THEIR CONCLUSIONS)* **We did document our conclusions in the overall document. We had little interest in writing down each decision for each box in the matrix.** of the degree to which operations impact the population. After the matrix scoring was completed we assigned relative weight factors to each component of the matrix *(BASED ON WHAT CRITERIA? HOW WERE THE WEIGHTING FACTORS DETERMINED? IT IS IMPORTANT THAT WE UNDERSTAND HOW THESE WEIGHTING CRITERIA WERE DERIVED. CRITERIA CAN BE USED TO JUSTIFY A PRECONCEIVED ANSWER. WE JUST NEED TO KNOW HOW THE FACTORS WERE SCORED AND WHY)*. **The weighting factors were judgement calls. However, we did not weight the matrices prior to any final tabulations to avoid biasing the outcome. We were as objective as possible and certainly have no interest in producing a particular alternative selection.**

We also limited the fall- winter periods to combinations of months which became self-weighting in the process since striped bass during these periods tend to be less vulnerable to diversions.

Existing conditions are the diversions as operated currently with the Bay-Delta Accord *(WE QUESTION WHETHER OR NOT IT IS APPROPRIATE TO USE THE ACCORD AS AN EVALUATION TOOL FOR LONG TERM ALTERNATIVE ANALYSIS SINCE THE ACCORD IS ONLY A TEMPORARY SET OF REGULATORY STANDARDS UNTIL A LONGER TERM SOLUTION CAN BE WORKED OUT.)* **Our understanding is that this was what the entire Diversion Effects Committee agreed to as existing conditions. If we misunderstood this then we will need to make some adjustments but we thought this was the given.** in place. An evaluation of full restoration conditions relative to the existing conditions and alternative choices was made to assess the extent to which the striped bass population would be restored *(THIS SENTENCE ASSUMES THAT THE TEAM KNOWS WHAT FACTORS AND CONDITIONS ARE NECESSARY TO ACHIEVE FULL RESTORATION OF STRIPED BASS. WE NEED TO HAVE A LIST OF THE FACTORS AND NEEDS, ALONG WITH THE SUPPORTING DATA AND ANALYSES USED TO SUPPORT THIS CONCLUSION.)* **As per the first comment,this was a judgemental evaluation process and we did not deem it possible to do any analyses. We have a perspective on what**

conditions were like before the decline and we scored the matrix accordingly.

with the proposed alternatives. All matrices were completed using the CALFED operations studies provided. This was a judgmental process with no striped bass modeling, data analysis, or quantitative assessments made because time constraints did not permit more rigor. In many cases we cannot be certain how the population might respond to the new conditions being proposed. *(THIS SENTENCE CALLS INTO QUESTION WHETHER OR NOT POPULATION LEVEL EFFECTS ARE REALLY KNOWN, OR ARE WE DEALING WITH LESS THAN POPULATION LEVEL EFFECTS.)* **We are not sure what the concern is here. Many population effects we think are known, some are not.**

Results

The following questions were evaluated:

1. **Which species, populations, and life stages are most sensitive to diversion effects under no action and alternatives 1, 2, and 3? When and where are they most affected?**

(ALL OF THE FOLLOWING EVALUATIONS ARE BASED ON THE OLD PARADIGM SO THE COMMENTS REGARDING NO ACTION APPLY TO THE REST OF THE ASSESSMENTS TOO.) **Our response is covered above.**

______**No Action**

Striped bass eggs and larva and juveniles are the life stages directly impacted by water diversions in the Delta during the first year of life from April through the fall and sometimes the winter. The impact on eggs and young fish up to 38 mm mean length occurs from April to July with further impacts on larger juveniles through the summer and fall. These impacts have been demonstrated for existing conditions (DFG 1992, Stevens et al, 1985) and would continue under the No Action Alternative. Total exports under the No Action Alternative during the spawning and nursery season are roughly the same as average existing conditions (CALFED 1998, Appendix A, E). Although average annual exports for the No Action are 6.5 percent higher than existing exports, most of the increase occurs from August to March. The added impact on striped bass during this period tends to be relatively small in wet years and greater in dry and critical years because of longer fish residence time in the Delta when flows are low.

It is unclear whether or not increased exports over current levels would further deplete the population of young striped bass in the Delta, since they may already be nearly depleted there under current export levels in dry and critical years. Under current conditions the population is likely to continue to decline in the absence of a hatchery stocking program (Striped Bass Management, Endangered Species Act Section 10 Conservation Plan). In recent years, young striped bass abundance has remained low despite higher than average delta outflows and low export rates, which are conducive to strong year classes. The most apparent cause is the continuing decline in egg production caused by average lower recruitment since the 1970's due to entrainment losses and higher mortality rates for adults in recent years. *(THIS ASSESSMENT IS TOTALLY CONSISTENT WITH THE OLD PARADIGM. HOWEVER, IT IS INCONSISTENT WITH KIMMERER'S WORK AND RECENT ASSESSMENTS BY OTHER DFG EMPLOYEES THAT EGG PRODUCTION MAY NOT BE LIMITING. ALSO, THE ENTIRE SOURCE OF PROBLEMS REGARDING THE STRIPED BASS DECLINE IS PLACED ON WATER FLOW PATTERNS. GIVEN THE WORK BY BENNETT ON OCEAN HARVEST EFFECTS AND THE FACT THAT STRIPED BASS POPULATIONS SPAWN HUNDREDS OF MILES UPSTREAM OF THE DELTA ON THE SACRAMENTO, AND IN SOME OF THE TRIBUTARIES TO THE SAN JOAQUIN, IT SEEMS HIGHLY UNLIKELY THAT THE STRIPED BASS POPULATION DECLINE IS SOLELY ATTRIBUTABLE TO WATER FLOW PATTERNS IN THE DELTA. ALSO, THIS ASSESSMENT IGNORES THE PARTICLE TRACKING MODEL RESULTS REGARDING THE LONG TRANSIT TIMES FOR EGGS AND LARVAE. REMEMBER, STRIPED BASS EGGS HATCH IN TWO DAYS AND LARVAE GROW AT A RATE OF APPROXIMATELY 0.5 MM/DAY. SO IN A FEW DAYS, THEY ARE VOLITIONAL SWIMMERS.)*

This is partly covered above in response to previous comments. Striped bass do not spawn hundreds of miles upstream of the delta. We suggest reviewers examine a scaled map of the Central Valley or California. Transport to the Delta occurs in a matter of a few days from the Sacramento River from spawning grounds between Sacramento and Colusa. Measurable spawning in tributaries of the San Joaquin River is likely only in very high flow years when flows are sufficient to attract fish to upstream areas and upstream salinity blocks have no effect. Also for the reviewers information, striped bass larvae average growth is around 0.2 mm per day not 0.5 mm/day which is a rate more characteristic of juveniles.

We have strong evidence that export pumping has a great impact on the population of both larvae and juveniles (DFG WRINT exhibit # 2). Tens to hundreds of millions of juveniles are lost at the fish screening facilities at the CVP and SWP export pumping plants. Young striped bass may be "volitional swimmers", but obviously lots of them apparently are swimming into the South Delta instead of away from it because they are either pumped to San Luis Reservoir, where there

is a striped bass fishery established by fish so entrained and pumped there, or salvaged and dumped back into the Delta(losses here due to warm water, handling and release site predation) or lost to predators in Clifton Court as well as indirect mortality by dislocation.

With regard to the reviewers comments on the particle tracking model, it is not clear whether they are critiquing the model because it is particle based and hence underestimates striped bass residence time or they think that it overestimates it because as bass grow they are volitional swimmers.

Alternative 1.

Under Alternative 1, we expect continued entrainment of eggs, larva, and juveniles in the south Delta. However, as the cross channel gates remain closed through the spawning season from April to June for winter-run chinook salmon protection, this would reduce the diversion of Sacramento River striped bass eggs and larvae in comparison to periods when the cross channel gates were open in years before the winter-run criteria went into effect. As in the past, eggs and larvae would move across the Delta from the Sacramento River through Georgiana and Three-mile sloughs and some would be entrained at the export facilities. *(WE DISAGREE WITH THIS CONCLUSION. THE PARTICLE TRACKING MODEL SHOWS A LENGTHY TIME PERIOD FOR PARTICLES RELEASED IN THE SACRAMENTO TO TRAVEL TO THE PUMPING PLANTS. ALSO, THIS CONCLUSION ASSUMES STRIPED BASS JUVENILES BEHAVE AS NEUTRALLY BUOYANT PARTICLES NO MATTER HOW OLD. THE PHYSICS, MATH, AND BIOLOGY DON'T MATCH UP IN THIS SITUATION. THE TEAM SHOULD FULLY DOCUMENT THEIR CONCLUSIONS.)* **This is covered above.**

Alternative 2.

Under alternative 2, increased numbers of eggs and larvae would be diverted and entrained from the Sacramento because fish screens at the Hood diversion would be inadequate to screen these stages. At the Clifton Court diversion, eggs, larvae, and juveniles would be continue to be entrained; some juveniles should be salvaged.

Adults would be affected because they would be attracted by the high proportion of Sacramento water flow in the Mokelumne River this channel and they would be trapped behind the fish screen at Hood. *(THE CALFED FISH SCREENING TEAM HAS CONCLUDED THAT ADULT STRIPED BASS CAN BE*

MOVED AROUND THE SCREENING FACILITY. BUELL COULD CONFIRM THIS STATEMENT. WE BELIEVE THIS ASSESSMENT IS IN ERROR.) **This could be in oversight. It was idenfified as one of the uncertainties as per the next sentence. At the time we did not know of any efficient method for striped bass. We will look into it and fix it if the data support a different conclusion. We do have a major concern about the feasibility, advisability and costs of moving several hundred thousand striped bass around a structure. However, Alt #3 avoids this issue and was scored accordingly.** There is no known way of passing striped bass over such structures, although some way of passing adults around the screen might be found, depending on the screen design. *(CONVERSATIONS WITH HYDRAULIC ENGINEERS AT THE CONTE FISH PASSAGE RESEARCH CENTER ON THE CONNECTICUT RIVER INDICATE THAT THE STATEMENT IS NOT TRUE. THEY ROUTINELY PASS STRIPED BASS BY TRAPPING AND ELEVATING THEM OVER THE DAM. THE SAME APPROACH COULD BE USED ON THE CANAL.)* If trapped adults spawn in the Mokelumne River, most of their progeny would be transported to the pumps and entrained. *(SEE EARLIER COMMENTS REGARDING VOLITIONAL BEHAVIOR, TRANSPORT TIMES, ETC.)* **This is covered above.** Thus, even if they spawn, these adults would not provide progeny to maintain the population. *(THIS STATEMENT ASSUMES 100% MORTALITY OF FISH SPAWNED IN THE MOKELUMNE RIVER. WE BELIEVE THIS IS A REAL STRETCH. WE WOULD LIKE TO SEE THE DATA USED TO SUPPORT SUCH A CONCLUSION.)* **We would likewise like to see data that indicates that a large proportion will escape the entrainment effects. We did not indicate 100 percent mortality but it is likely that entrainment losses will be extremely high under this scenario. Under low flow conditions, striped bass losses are very high (see percent reduction analysis in WRINT Exhibit #2) under existing conditions where bass do not spawn in the direct path of water movement to the pumps.** It is unknown what proportion of the population might use this channel to attempt to access the Sacramento River. If flows diverted at Hood are a large proportion of the Sacramento flow, as might occur in dry years, more fish might be attracted to the Mokelumne as a corridor to the spawning grounds. Striped bass tagged in the San Joaquin River are commonly recaptured within a few weeks from the Sacramento River above Sacramento, but it is unknown which pathways from the San Joaquin to the Sacramento River are most important.

Alternative 3.

This alternative would divert eggs and larvae from both rivers as well as juveniles from the San Joaquin, depending on operations. If the diversion is reduced at Hood during the striped bass spawning season, then diversion of eggs and larva from the Sacramento River would be reduced. Adults would not be affected because the facility is isolated and screened so adults spawning in the Sacramento River would be able to pass the facility intake in both directions without being adversely affected.

When diversion occurs in the south Delta, entrainment would continue for eggs, larvae, and juveniles from the San Joaquin River and through other Delta channels. However, since QWEST flows would be much improved over existing conditions and less water would be diverted from the south Delta we expect less entrainment of striped bass.

2._____Can diversion effects in the South Delta be offset by habitat improvements and other common program actions?

Striped bass can use various habitats to rear, including shallow water. Any improvements in habitat in Suisun Bay or in other areas secure from entrainment effects could help striped bass; however, there is no way to determine, a priori, if such habitat change would offset entrainment losses and indirect mortality from transport flow reductions ***(ASSUMES THE CONTROLLING FACTOR IN STRIPED BASS POPULATIONS DYNAMICS IS FLOW. IGNORES WIM'S WORK AND BENNETT'S WORK AND THE EMPIRICAL DATA.)*****This is covered above.** on the Sacramento River.

Reduction in toxicants may improve striped bass survival, but toxicants have not been identified as a major controlling factor for the striped bass population. Hence, population increases resulting from this program would likely be small.

Some common programs may adversely affect striped bass and other fish populations if nutrients and turbidity are reduced. For example, if nutrients, carbon input, and primary production are decreased this would reduce the food supply for fish. Turbidity reduction could result in increased predation on young fish.

3. **To what extent can alternatives 1, 2, and 3 offset diversions effects as presently configured?**

All three alternatives screen the intake to Clifton Court Forebay which reduces predation losses now occurring in Clifton Court. The No Action choice would continue the predation losses. ***(THIS CONCLUSION ASSUMES THAT THE SCREENING OF CLIFTON COURT FOREBAY IS THE ONLY ACTION IN ALTERNATIVES 1, 2, AND 3 THAT WOULD OFFSET DIVERSION EFFECTS. DID THE TEAM CONSIDER THE FACT THAT THE DIVERSION LOSSES IN DIVERSIONS OTHER THAN THE SWP COULD BE SCREENED BY THE SCREENING PROGRAM. IT APPEARS THAT THE TEAM DID NOT ADEQUATELY CONSIDER THE OTHER ACTIONS INCLUDED AND REPORT THEIR EVALUATION AS PART OF THE ANSWER TO THIS QUESTION.)*** **This is something we need to address in regard to common programs. Screening all diversions would be positive but all diversions may not have the same impacts and there is little data to evaluate the relative impacts.**

Alternative 1.

Alternative 1 offers marginally improved conditions for striped bass compared to existing conditions by elimination of predation on young striped bass in Clifton Court Forebay. However, striped bass in the Delta would still be exposed to large potential entrainment losses due to screen inefficiencies, handling mortality, and indirect losses. This alternative maintains flows in the Sacramento River below Hood as occurs under present conditions providing for faster transport of striped bass out of the river and into the lower river and Suisun Bay than either Alternatives 2 or 3. Striped bass survival between egg and larva stages increases with increased river flow (IESP 1994). ***(THIS SENTENCE ASSUME THAT EGG AND LARVAL SURVIVAL IS THE KEY TO ADULT POPULATION LEVELS. SEE EARLIER COMMENTS REGARDING KIMMERER'S WORK THAT QUESTIONS THIS ENTIRE ASSUMPTION.)*** **No, we did not say it is the key but it is very important to enhance early survival from egg stage to 6mm size. We have never seen a strong striped bass year class at the 38-mm index measurement when 6 mm larva abundance is low.**

Alternative 2.

Alternative 2 would decrease the diversion of striped bass in the South Delta by creating more positive net flows in the San Joaquin River. ***(SEE PREVIOUS COMMENTS ON FLOW ONLY PARADIGM AND PARTICLE TRACKING MODEL RESULTS. ALSO, THIS STATEMENT IGNORES WIM AND BENNETT'S WORK.)*** **With respect to Bennett's, work**

what is it's relevance here? Operation studies indicate that net San Joaquin flows at Antioch would be positive for all months of the year and in April-July would be about double the No Action conditions or conditions under Alternative 1. However they are still small relative to the tidal volume. On average, reverse flows would no longer occur on the San Joaquin River (based on operations studies: QWEST, years 1921-1994, Flow at Antioch, 1975-1991). However, as the Hood diversion reduces transport flows for larvae, would trap significant number of adults behind a fish screen, and entrain large numbers of eggs and larvae from the Sacramento River, this alternative would provide worse conditions for striped bass than existing diversion conditions. The extent of impact is uncertain given the unknowns associated with the above. How these facilities are operated to minimize impacts during the spawning season is important. ***(MOST OF THE EARLIER COMMENTS APPLY TO THIS ASSESSMENT)***

Alternative 3.

The use of Alternative 3 in lieu of existing conditions for times of the year other than the striped bass spawning period would greatly reduce the entrainment losses now occurring in the south Delta. Additionally, because it is an isolated facility, it would not attract and trap adult fish behind a fish screen at Hood. The diversion of eggs and larvae during the spawning season and reduced transport flows would be detrimental to striped bass. If the facility were operated to minimize such diversions when striped bass spawn and south Delta diversions were also minimized during the spawning and nursery period, this would provide greatly improved conditions for striped bass. Positive flows in the San Joaquin River would be good for striped bass spawning in the San Joaquin River; it would move them west to better nursery conditions and away from entrainment. This alternative scored highest in the matrix exercise.

4._____To what extent can diversion effects be offset by modifications to the alternatives or by operational changes?

How the diversion is operated and the timing of diversion is very important for striped bass. Reductions in April to July exports in the south Delta and of diversions at Hood during the striped bass spawning season would greatly lessen impacts on the population. Under both Alternatives 2 and 3, minimizing the Hood diversion during striped bass spawning pulses would have a positive effect by keeping eggs and larvae in the river and providing adequate downstream transport flows. ***(THIS ASSESSMENT ONLY ADDRESSES OPERATIONAL CHANGES. IT ASSUMES THAT DIVERSIONS ARE THE SINGLE CAUSAL FACTOR RELATING TO STRIPED BASS POPULATION DECLINES. NO MENTION OF INCREASING PRODUCTION,***

REDUCING TOXICANTS, SCREENING OTHER FACILITIES, HARVEST RESTRICTIONS, PREDATOR REDUCTIONS, ETC. IT APPEARS THAT THIS RESPONSE IS INCOMPLETE AND NEEDS FURTHER DEVELOPMENT.)

We believe this question had to do with diversion operations. Some of these factors have been identified as positive elsewhere under common programs. However it is difficult to assess their merits because harvest rates, toxicants and predation are apparently not major drivers of the population dynamics. .

5.____What is the risk and chances of success of species recovery for each alternative?

The striped bass population has been declining. The adult population is affected by reduced recruitment as a result of early life stage losses without sufficient density-dependent survival (compensation) to maintain the numbers of adults that were historically present. Although some compensation is apparently occurring between the young-of-the-year abundance and recruitment at age 3, the population of adults, which numbered 1.8 million in the early 1970's, has declined to about 700,000 presently. Recovery cannot occur under the No Action Alternative. Alternatives 1 and 2 appear to exacerbate present striped bass population stressors. Alternative 3 still falls short of full restoration to historic population levels (see matrix page 8); largely because water demands exclude achievement of full restoration conditions. Alternatives 3, if operated in a manner which minimized entrainment of young striped bass, provides the best opportunity for some restoration of the population. *(THIS ENTIRE ASSESSMENT IS BASED ON THE FLOW PARADIGM AND DIVERSION LOSSES. ALL OF THE EARLIER COMMENTS APPLY.)* **The response has been covered too, and we pointed out the lack of full compensation here in this section but perhaps the reviewers missed it.**

Additional technical questions were posed and the responses are included here:

1. **What increment of protection or improvement for fish species will be provided by other programs such as the Central Valley Project Improvement Act, biological opinions, etc.?**

This is difficult to evaluate since the amount of water allocated to fish restoration efforts has not been firmly committed to any striped bass restoration scenarios. *(THIS RESPONSE ASSUMES THAT THE ONLY VARIABLE IMPORTANT TO STRIPED BASS IS THE AMOUNT OF WATER AVAILABLE TO CHANGE OR ALTER FLOW PATTERNS IN THE DELTA. WE DISAGREE WITH THIS ASSESSMENT. SEE ALL PREVIOUS*

COMMENTS.) **<u>We think that this is what the alternative evaluation process is mainly about.</u>**

2 **What degree of benefit and impact will the common programs provide?**

The common programs will likely provide some benefits but these are difficult to quantify. Increasing the amount of marsh habitat for nursery areas adjacent to Suisun Bay and in San Pablo Bay would increase survival of young striped bass. Reducing point and non-point sources of toxic chemicals and metals would improve conditions for fish but because such impacts are not now quantified it is difficult to be certain of the degree of benefit. Toxicants have not been identified as a factor which determines population size. As mentioned previously, reduction of organic input and decreasing turbidity may adversely effect fish production.

3. **What are the direct and indirect effects on fish populations resulting from each alternative and what is the expected response of the populations to these effects?**

Covered in answers to questions 1-6 in the first section above.

4. **What Sacramento River flow is required below a Hood diversion to protect salmon, striped bass and delta smelt?**

Transport flows to move striped bass into the estuary apparently are very important. When large numbers of striped bass eggs and larva are moving down the Sacramento River, diversion should stop or be minimized to reduce the impact of entrainment and to assure sufficient transport to promote the survival of larvae. Diversion which caused either no flow or reverse flows in the Sacramento River below the diversion intake would likely be very detrimental to young striped bass. *(THIS CONCLUSION SHOULD BE SUPPORTED BY DATA AND ANALYSES. NO POPULATION LEVEL EFFECTS DEMONSTRATED. THE OLD FLOW PARADIGM IS DRIVING THIS CONCLUSION. ALL PREVIOUS COMMENTS APPLY.)* **Data that has been included IEP Annual Reports, DFG WRINT Exhibit #2 and in Kimmerer et al., demonstrates that survival of early stages is dependent on transport flows.**

5. **What survival rate can be expected for striped bass eggs and larvae and delta smelt passing through the Sacramento River screen and pumps in Alternative 2?**

We would expect that most striped bass eggs and larvae would be entrained with water diverted at Hood and channeled to the pumping plants and therefore survival would be very low. *(THIS CONCLUSION IGNORES THE RESULTS OF PARTICLE TRACKING MODEL RESULTS AND ANY VOLITIONAL BEHAVIOR BY THE*

FISH. NO POPULATION LEVEL EFFECTS DEMONSTRATED.) Some would likely be caught in the tidal volume and move back and forth in the San Joaquin River and of these some might avoid entrainment by moving beyond the influence of the pumps depending on San Joaquin River net flows. However net flows are low relative to the tidal volume as previously indicated which suggests that residence time within the influence of the pumps will be long. Modeling of the hydrodynamics might be helpful to estimating the proportion of striped bass larvae and juveniles lost to pumping. *(YOU CAN COUNTER THIS PERCEPTION ABOUT EVERYTHING BEING DRUG SOUTH TO THE PUMPS BY INCREASING THE SURFACE AREA AND VOLUME OF THE COMMON POOL IN THE NORTH CENTRAL DELTA. REFER TO THE CUWA CONFIGURATION C AS TO HOW THIS WOULD WORK.)* **We have not seen the CUWA configuration C. Is there supporting evidence that residence time would be so increased by this configuration that there would be no entrainment and no "volitional swimming" toward the export facilities?**

6. **Should there be a screen on the Sacramento River intake of Alternative 2?**

A screen for striped bass eggs and larvae, if feasible, would likely be very expensive and difficult to maintain in a debris free state. A screen should be resorted to only if flexibility in operations cannot accommodate striped bass spawning.

7. **What are the logical stages for a preferred alternative?**

Alternative 3 is the preferred alternative for striped bass. It is not clear how this could be built in stages based on biological considerations.

8. **What is the range of biological criteria that should be considered in operations of the three alternatives?**

We are not sure what criteria are expected here.

Alternative 1. - Fish screens need to be improved and handling and trucking mortality greatly reduced.

Alternatives 2 and 3 .- Reduction in diversion during the spawning season on the Sacramento River. Maintenance of transport flows during the spawning season.

Uncertainties

There are many uncertainties in this evaluation, both large and small. Even with further data exploration, there is much that would remain speculative in our assessment of potential benefits and detriments. First, there is the uncertainty regarding how much striped bass entrainment losses will be reduced and access to nursery areas enhanced with positive downstream flows rather than reverse flows in the San Joaquin River. Is it a little or a lot? Similarly, when Sacramento River flows necessary for larvae transport are greatly reduced below Hood, how much will this affect the survival of striped bass left in the river? At this location, transport flows obviously become more important in years of low inflow. The proportion of the adults that would use the Mokelumne as a migration corridor to the Sacramento River spawning ground is unknown. If that proportion is small, it will have a minor effect; if large it will have a major negative impact.

Additional Issues

<u>References</u>

California Department of Fish and Game. 1992. A re-examination of factors affecting striped bass abundance in the Sacramento-San Joaquin estuary. WRINT-DFG-Exhibit 2. Entered by the California Department of Fish and Game for the State Water Resources Control Board 1992 Water Rights Phase of the Bay-Delta Estuary Proceedings. 59 p.

IESP. 1994. 1992 Annual Report. Interagency Ecological Studies Program for the Sacramento-San Joaquin Estuary.

Stevens, D. E., D. W. Kohlhorst, L. W. Miller, and D. W. Kelley. 1985. The decline of striped bass in the Sacramento-San Joaquin Estuary, California. Transactions of the American Fisheries Society 114:12-30.

Appendix I. Matrices